

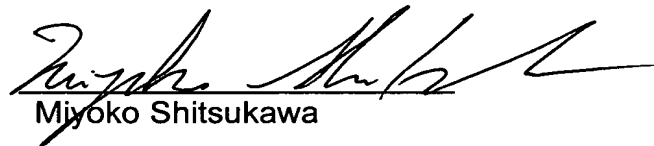


## DECLARATION

In the matter of US Patent Application in the  
name of SUMITOMO WIRING SYSTEMS,  
LTD.

I, the undersigned, Miyoko Shitsukawa, of Müller-Boré & Partner, of Grafinger  
Straße 2, D-81671 Munich, Germany, do hereby declare that I am the translator of  
the documents attached and certify that the following is a true translation of No.  
300950/2002 to the best of my knowledge and belief.

Dated this 30<sup>th</sup> of June, 2005

  
Miyoko Shitsukawa

SPECIFICATION

TITLE OF THE INVENTION

A Connector

CLAIMS

1. A connector having a connector housing formed with a cavity into which a terminal fitting is insertable from behind, wherein:

the connector housing is divided into an inner housing and an outer housing into which the inner housing is mountable from front,

a receiving portion engageable with a lock portion provided in the inner housing to undetachably hold the inner housing is provided in the outer housing, and

a locking surface of the receiving portion engageable with the lock portion is exposed backward to outside through the cavity.

2. A connector according to claim 1, wherein the lock portion also serves as an inner wall of the cavity while being engaged with the receiving portion.

3. A connector according to claim 2, wherein the cavity is formed such that a larger portion at the rear side is connected with a smaller portion at the front side via a tapered portion, and the lock portion is formed with a slanted surface to extend substantially along the tapered portion.

DETAILED DESCRIPTION OF THE INVENTION

[0001]

[Technical Field of the Invention]

The present invention relates to a connector.

[0002]

[Prior Art]

One example of a connector in which a connector housing is divided into an inner housing and an outer housing is known from the following patent document 1. This connector is, as shown in FIG. 16, constructed such that an outer housing 1 includes a receptacle 3 into which an inner housing 2 is mountable from front, a receiving portion 5 for undetachably holding the inner housing 2 by the engagement with a lock portion 4 provided on an outer surface of the inner housing projects inward from an inner surface of the receptacle 3. A stepped portion 6 with which the rear end of the inner housing 2 is brought into contact to position the inner housing 2 is formed at the back side of the receptacle 3. Further, a retainer 9 for locking terminal fittings 8 inserted into cavities 7 is mountable into the inner housing 2.

[0003]

[Patent Document 1]

Japanese Unexamined Patent Publication No. 2000-208195

[0004]

[Problems the Invention Seeks to Solve]

A locking surface 5a of the receiving portion 5 engageable with the lock portion 4 is opposed to the stepped portion 6 located behind. Accordingly, upon resin-molding the outer housing, a slidable mold slidable along widthwise direction is necessary to form the locking surface 5a of the receiving portion 5 in addition to a pair of molds which are opened and closed along forward and backward directions.

However, the use of the slidable mold unavoidably leads to higher costs and necessitates a certain space for a driving construction for the slidable mold. Thus, there has been a restriction on the size of produceable connectors and it has been difficult to produce connectors smaller than them.

The present invention was developed in view of the above problems and an object thereof is to miniaturize a connector while reducing production costs.

[0005]

[Means to Solve the Problems]

In order to accomplish the above object, the invention according to claim 1 is directed to a connector having a connector housing formed with a cavity into which a terminal fitting is insertable from behind, wherein:

the connector housing is divided into an inner housing and an outer housing into which the inner housing is mountable from front,

a receiving portion engageable with a lock portion provided in the inner housing to undetachably hold the inner housing is provided in the outer housing, and

a locking surface of the receiving portion engageable with the lock portion is exposed backward to outside through the cavity.

[0006]

The invention according to claim 2 is characterized in that, in the connector according to claim 1, the lock portion also serves as an inner wall of the cavity while being engaged with the receiving portion.

[0007]

The invention according to claim 3 is characterized in that, in the connector according to claim 2, the cavity is formed such that a larger portion at

the rear side is connected with a smaller portion at the front side via a tapered portion, and the lock portion is formed with a slanted surface to extend substantially along the tapered portion.

[0008]

[Functions and Effects of the Invention]

<Invention according to claim 1>

When the inner housing is mounted into the outer housing from front, the lock portion is engaged with the receiving portion to undetachably hold the inner housing in the outer housing. Thereafter, the terminal fitting is inserted into the cavity from behind.

Since the locking surface of the receiving portion engageable with the lock portion is exposed backward to outside through the cavity, it can be formed by a mold removed backward using the cavity when the outer housing is formed. Accordingly, it is not necessary to use a so-called slidable mold in order to form the locking surface of the receiving portion unlike the prior art, with the result that the connector can be miniaturized while reducing production costs.

[0009]

<Invention according to claim 2>

When the terminal is inserted into the cavity, the insertion thereof can be guided by the lock portion serving also as the inner wall of the cavity.

[0010]

<Invention according to claim 3>

In the case of detaching the inner housing from the outer housing, a disengagement jig is, for example, inserted into the cavity from behind to push

the slanted surface of the lock portion, whereby the lock portion is disengaged from the receiving portion. Since the slanted surface of the lock portion has such an inclination substantially along the tapered portion, the lock portion can be easily disengaged only by inserting the disengagement jig straight into the cavity in forward and backward directions, thereby improving a detaching operability.

[0011]

[Embodiments of the Invention]

One embodiment of the present invention is described with reference to FIGS. 1 to 15. A male connector having a watertight function is illustrated in this embodiment. This male connector is provided with a connector housing H for accommodating male terminal fittings 10. This connector housing H is divided into an inner housing 20 and an outer housing 50, and a retainer 26 for locking the male terminal fittings 10 is mountable into the inner housing 20. In the following description, a side toward which the male terminal fittings 10 are inserted is referred to as front and reference is made to FIGS. 1 and 5 concerning vertical direction.

[0012]

Each male terminal fitting 10 is press-formed of a metallic plate and comprised of a substantially box-shaped main portion 11, a tab 12 projecting forward from the main portion 11 and electrically connectable with a mating female terminal fitting (not shown), and a barrel portion 13 projecting backward from the main portion 11 and to be crimped into connection with an end of a wire D. A cantilever-shaped metallic locking portion 14 having the front end thereof supported is formed in the bottom surface of the main portion 11 by

cutting and bending. A jaw portion 16 engageable with the retainer 26 is provided at a rear bottom part of the main portion 11. The barrel portion 13 includes front and rear pairs of crimping pieces 13a, 13b, wherein the crimping pieces 13a at the front side are crimped into connection with a core of the wire D and the crimping pieces 13b at the rear side are crimped into connection with a rubber plug 17 mounted on an insulation coating of the wire D.

[0013]

As shown in FIGS. 6 to 8, five cavities C into which the male terminal fittings 10 are insertable from behind are arranged side by side in widthwise direction in the connector housing H. Each cavity C is formed to have a substantially rectangular cross section over the entire length and the dimensions thereof differ at the front and rear sides. Specifically, a front part of the cavity C is formed into a smaller portion 22 having a substantially square cross section and adapted to accommodate the main portion 11 of the male terminal fitting 10 and the front crimping pieces 13a of the barrel portion 13; a rear part thereof is formed into a larger portion 52 having a vertically long rectangular cross section and adapted to accommodate the rubber plug 17; and a middle part thereof is formed into a tapered portion 53 connecting the larger portion 52 and the smaller portion 22, having the height thereof gradually reduced from a side of the larger portion 52 (rear side) toward a side of the smaller portion 22 (front side) and adapted to accommodate the rear crimping pieces 13b of the barrel portion 13. Since this connector housing H is divided into the outer housing 50 and the inner housing 20, the cavities C are similarly divided. The larger portions 52 and the tapered portions 53 are provided in the

outer housing 50, whereas the smaller portions 22 are provided in the inner housing 20.

[0014]

The inner housing 20 is made of a synthetic resin and includes a main portion 21 substantially in the form of a laterally long block, and the smaller portions 22 of the respective cavities C are provided in this main portion 21 as shown in FIGS. 1 to 5. A locking groove 23 having an open front end is formed in the bottom surface of each smaller portion 22, and the metallic locking portion 14 of the corresponding male terminal fitting 10 is engageable with the rear surface of the locking groove 23. A stabilizer insertion groove 24 along which a stabilizer 15 of the male terminal fitting 10 can pass is so formed as to be open backward at the right end of the bottom surface of each smaller portion 22 in FIG. 2.

[0015]

A retainer mount recess 25 into which the retainer 26 is mountable in widthwise direction is formed in the left surface of the main body 21 in FIG. 1. This retainer mount recess 25 is formed by recessing the outer surface of the main portion 21 into such a shape in conformity with the retainer 26. The retainer mount recess 25 is so formed as to cross the respective smaller portions 22 at a position slightly behind the locking grooves 23, whereby the entrance of the retainer 26 into the smaller portions 22 is permitted. Specifically, bottom walls 22a and lower halves (the side wall 22b at the left end in FIG. 9 is entirely cut off) of side walls 22b of the respective smaller portions 22 are cut off by the retainer mount recess 25 (see FIG. 9).

[0016]



The retainer 26 is made of a synthetic resin and has a main portion 27 substantially U-shaped when viewed from front. The upper surface of a bottom part of the main portion 27 is formed into such a shape in conformity with the inner circumferential surfaces of the respective smaller portions 22, and communication grooves 28 which can communicate with the respective stabilizer insertion grooves 24 and locking sections 29 engageable with the corresponding male terminal fittings 10 are formed in and on this upper surface. The locking sections 29 can also serve as the side walls 22b of the smaller portions 22 of the respective cavities C. A guiding portion 30 in the form of a flat plate having a specified width and adapted to guide a mounting operation of the retainer 26 projects forward from the lower side of the bottom part of the main portion 27. A retainer operating portion 31 enabling the retainer 26 to be operated from outside projects from the front end surface of this guiding portion 30.

[0017]

A retainer holding portion 32 for holding the retainer 26 in the inner housing 20 projects from an upper side of an upper part of the main portion 27 of the retainer 26 up to the same position as the guiding portion 30. The retainer holding portion 32 is comprised of a pair of arms 32a extending forward, a substantially arcuate thin flexible portion 32b coupling the front ends of the two arms 32a, and a holding projection 32c projecting from the lower surface of the flexible portion 32b. The retainer 26 can be held either at a partial locking position or at a full locking position by the engagement of the holding projection 32c with a partial locking groove 33 or a full locking groove 34 formed in the upper surface of the main portion 21 of the inner housing 20

and is movable along widthwise direction between these two positions. At the partial locking position, the respective communication grooves 28 communicate with the corresponding stabilizer insertion grooves 24 and the respective locking sections 29 are retracted sideways from the corresponding smaller portions 22 to serve as the side walls 22b. Thus, the insertion and withdrawal of the male terminal fittings 10 into and from the cavities C are permitted (see FIGS. 6 to 9). On the other hand, the respective locking sections 29 enter the corresponding smaller portions 22 to engage the jaw portions 16 of the male terminal fittings 10 (see FIGS. 12 to 14). In a mounted state of the retainer 26, the retainer holding portion 32 and the guiding portion 30 have their front ends aligned with the front end of the inner housing 20 while being caused to escape by the retainer mount recess 25, and the retainer operating portion 31 projects more forward than the front end surface of the inner housing 20.

[0018]

The inner housing 20 is mountable into the outer housing 50 from front with the retainer 26 mounted therein, and a lock portion 35 for holding the inner housing 20 assembled with the outer housing 50 projects backward from the rear end surface of the main portion 21. This lock portion 35 is cantilever-shaped and comprised of a flexible arm 36 resiliently displaceable upward and downward and a claw 37 projecting from a lower side of the leading end of the flexible arm 36 and narrower than the flexible arm 36. The front surface of the claw 37 is formed into a locking surface 37a extending substantially vertically and engageable with a receiving portion 59 to be described later, whereas the rear surface thereof is formed into a slanted surface 37b sloped upward to the back (having such an inclination substantially along slanted surfaces 53c, 53d

of the tapered portion 53 to be described later) and continuous with an arcuate surface 36a formed on the rear surface of the flexible arm 36. A restricting wall 38 for restricting a mounting depth of the inner housing 20 into the outer housing projects on the upper surface of the main portion 21 behind the retainer mount recess 25. A restricting portion 39 having a similar function is provided at the right end of the upper surface of the main portion 21 in FIG. 1. On the other hand, a laterally long rib 40 projects forward from the front end surface of the upper part of the main portion 21, and the upper surface thereof is in flush with the upper surface of the main portion 21. The partial locking groove 33 and the full locking groove 34 are so formed in the upper surface of the rib 40 as to be open forward in order to facilitate the molding (see FIG. 3).

[0019]

The outer housing 50 is made of a synthetic resin into a substantially laterally long block shape, and is comprised of a main portion 51 in which the larger portions 52 and the tapered portions 53 of the respective cavities C are provided and a receptacle 54 substantially in the form of a rectangular tube projecting forward from the main portion 51. In a rear part of the receptacle 54, the inner upper and lower surfaces are caused to bulge out inward and stepped with respect to a front part, thereby forming an inner-housing accommodating portion 55 for accommodating the inner housing 20. The front part of the receptacle 54 serves as a female-connector fitting portion 56 into which a mating female connector (not shown) is fittable. The restricting wall 38 and the restricting portion 39 of the inner housing 20 can be stopped by the front surface of the main portion 51.

[0020]

Here, the tapered portion 53 is described in detail. The lower surface of the tapered portion 53 includes a slanted surface 53a sloped upward toward the front from the side of the larger portion 52 and a horizontal surface 53b horizontally extending forward from the slanted surface 53a. On the other hand, the upper surface of the tapered portion 53 includes a first slanted surface 53c sloped downward toward the front from the side of the larger portion 53 and a second slanted surface 53d located before and slightly steeper than the first slanted surface 53c. The rear end position of the first slanted surface 53c is located more forward than that of the slanted surface 53a. A protrusion 57 whose rear surface is a slanted surface steeper than the slanted surface 53a is provided at a front-left end of the lower surface of the tapered portion 53 in FIG. 2.

[0021]

A recess 58 into which the lock portion 35 of the inner housing 20 is insertable is so formed as to have an open front end above the second cavity C from the left in FIG. 1 in the front surface of the main portion 51. This recess 58 is caused to communicate with the tapered portion 53 via the receiving portion 59 formed by partially cutting off an upper wall 53e of the tapered portion 53 of the above cavity C. The receiving portion 59 is formed by cutting off the first slanted surface 53c of the upper wall 53e of the tapered portion 53 by a specified width over the entire length, and the claw 37 of the lock portion 35 can enter this receiving portion 59. Accordingly, the claw 37 of the lock portion 35 can also serve as the upper wall 53e of the tapered portion 53. The front surface of the receiving portion 59 is formed into a locking surface 59a which is a substantially vertical end surface engageable with the locking surface

37a of the lock portion 35. The locking surface 59a of the receiving portion 59 is exposed backward to outside through the cavity C (see FIGS. 2 and 5). The slanted surface 37b of the lock portion 35 has substantially the same inclination as the second slanted surface 53d, and the slanted surface 37b of the lock portion 35 and the second slanted surface 53d form one continuous slanted surface in the locked state of the inner housing 20 (see FIG. 8).

[0022]

Next, an operation of assembling the male connector is described. The retainer 26 is mounted into the inner housing 20 and located at the partial locking position in the state shown in FIG. 5, and the inner housing 20 is accommodated into the inner-housing accommodating portion 55 of the outer housing 50 from front in this state. In this process, the claw 37 of the lock portion 35 moves onto the bottom surface of the recess 58 while being guided by the slanted surface 37b thereof, and the flexible arm 36 is resiliently displaced upward in the recess 58. When the inner housing 20 is mounted to a proper depth, the claw 37 enters the receiving portion 59 and the flexible arm 36 returns to engage the locking surfaces 37a, 59a, whereby the inner housing 20 is undetachably held in the outer housing 50 and the restricting wall 38 and the restricting portion 39 come into contact with the front surface of the main portion 51 to restrict a mounting depth. In this state, the claw 37 of the lock portion 35 partly serves as the upper wall 53e of the sloped portion 53 of the cavity C.

[0023]

Thereafter, the male terminal fittings 10 are inserted into the respective cavities C from behind. In the inserting process, the insertion of the male

terminal fittings 10 is guided by the passage of the stabilizers 15 along the stabilizer inserting grooves 24 and the communication grooves 28. Even if the longitudinal axis of the male terminal fitting 10 is inclined in the inserting process as shown in FIG. 10, the tab 12 comes into sliding contact with the slanted surface 37b of the lock portion 35 and the inner surfaces 53a to 53d of the tapered portion 53, thereby correcting the orientation of the male terminal fitting 10 being inserted into a straight orientation. It should be noted that the flexible arm 36 of the lock portion 35 has such a sufficient rigidity as not to be resiliently displaced by a light pushing force exerted by the tab 12 held in sliding contact. When the male terminal fitting 10 is inserted to a proper depth in the cavity C, the resiliently deformed metallic locking portion 14 is restored to engage the rear surface of the locking groove 23 as shown in FIG. 11, whereby the male terminal fitting 10 is partly locked.

[0024]

After the insertion of all the male terminal fittings 10, the retainer operating portion 31 is pressed by inserting a jig or the like into the receptacle 54 from front to move the retainer 26 to the full locking position shown in FIG. 12. Then, as shown in FIGS. 13 and 14, the respective locking sections 29 enter the smaller portions 22 of the corresponding cavities C and engage the jaw portions 16 of the corresponding male terminal fittings 10, thereby fully locking the male terminal fittings 10. As a result, the male terminal fittings 10 can be doubly locked so as not to come out of the cavities C. Thereafter, the unillustrated female connector is fitted into the female-connector fitting portion 56 of the receptacle 54.

[0025]

In the case of checking whether or not the retainer 26 and the inner housing 20 are damaged or in the case of exchanging the retainer 26 and the inner housing 20 at the time of maintenance, each male terminal fitting 10 is withdrawn after being disengaged from the metallic locking portion 14 by forcibly resiliently deforming the metallic locking portion 14 by means of a specified jig while the retainer 26 is moved to the partial locking position. Thereafter, a bar-shaped disengagement jig J is inserted into the second cavity C from the right in FIG. 7 from behind. When the disengagement jig J is inserted straight in forward and backward direction while being held in sliding contact with the upper surface of the cavity C, the slanted surface 37b of the claw 37 is pushed by this disengagement jig J and the flexible arm 36 is forcibly resiliently displaced to cancel the locked state while being guided by the inclination of the slanted surface 37b. Operability is good since the locked state can be canceled only by inserting the disengagement jig J straight in this way. Thereafter, the inner housing 20 is withdrawn forward from the receptacle 54.

[0026]

As described above, according to this embodiment, the locking surface 37a of the receiving portion 59 engageable with the lock portion 35 is exposed backward to outside through the cavity C. Thus, upon resin-molding the outer housing 50, the locking surface 59a of the receiving surface 59 can be formed by a mold removed backward using the larger portion 52 of the cavity C. Accordingly, it is not necessary to use a so-called slidable mold in order to form the locking surface of the receiving portion unlike the prior art, with the result that the connector can be miniaturized while reducing production costs.

[0027]

Further, since the claw 37 of the lock portion 35 also serves as the upper wall 53e of the tapered portion 53 of the cavity C while being engaged with the receiving portion 59, the insertion of the male terminal fitting 10 can be guided by the lock portion 35 serving as the upper wall 53e of the cavity C when the male terminal fitting 10 is inserted into the cavity C.

[0028]

Furthermore, since the slanted surface 37b of the lock portion 35 has such an inclination substantially along the tapered portion 53, the lock portion 35 can be easily disengaged from the receiving portion 59 only by inserting the disengagement jig J straight into the cavity C in forward and backward directions from behind, thereby improving a detaching operability.

[0029]

<Other Embodiments>

The present invention is not limited to the above described and illustrated embodiment. For example, the following embodiments are also embraced by the technical scope of the present invention as defined by the claims. Beside the following embodiments, various changes can be made without departing from the scope and spirit of the present invention as defined by the claims.

(1) Although the lock portion includes the flexible arm and the receiving portion is in the form of a recess in the foregoing embodiment, an embodiment, for example, in which the receiving portion includes a flexible arm projecting from the front surface of the main portion of the outer housing and a claw provided at the leading end of the flexible arm, a locking surface of the claw is exposed backward to outside through the cavity, and the lock portion is



in the form of a recess (groove) formed in the outer surface of the inner housing is also embraced by the present invention.

[0030]

(2) Although the receiving portion is formed in the tapered portion of the cavity in the foregoing embodiment, it may be formed in the larger portion of the cavity according to the present invention. In the case that the outer housing partially forms the smaller portions of the cavities, the receiving portion may be formed in the smaller portion.

(3) Although the cavities are so formed as to have a substantially rectangular cross section over the entire length in the foregoing embodiment, they may be so formed as to have a round cross section over the entire length or have its rear half formed to have a round cross section while having its front half formed to have a substantially rectangular cross section according to the present invention.

[0031]

(4) Although the retainer is of the side type directly engageable with the male terminal fittings in the foregoing embodiment, the present invention is also applicable, for example, to connectors including no retainer.

(5) Although the male connector is illustrated in the foregoing embodiment, the present invention is similarly applicable to female connectors.

(6) Although the watertight connector is illustrated in the foregoing embodiment, the present invention is also applicable to nonwatertight connectors.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of an outer housing, an inner housing and a retainer according to one embodiment of the invention,

FIG. 2 is a rear view of the outer housing, the inner housing and the retainer,

FIG. 3 is a plan view of the inner housing and the retainer,

FIG. 4 is a left side view of the inner housing and the retainer,

FIG. 5 is a section along X-X of FIG. 1,

FIG. 6 is a front view showing a state where the inner housing is mounted in the outer housing and the retainer is located at a partial locking position,

FIG. 7 is a rear view showing a state where the inner housing having the retainer mounted therein is mounted in the outer housing,

FIG. 8 is a section along X-X of FIG. 6,

FIG. 9 is a section along Y-Y of FIG. 8,

FIG. 10 is a section along X-X of FIG. 6 showing an intermediate state of the insertion of a male terminal fitting in an inclined orientation,

FIG. 11 is a section along X-X of FIG. 6 showing a state where the male terminal fitting is inserted to a proper depth,

FIG. 12 is a front view showing a state where the inner housing is mounted in the outer housing and the retainer is located at a full locking position,

FIG. 13 is a section along X-X of FIG. 12,

FIG. 14 is a section along Y-Y of FIG. 13,

FIG. 15 is a section along X-X of FIG. 6 showing a state where a disengagement jig for disengaging a lock portion is inserted into a cavity, and

FIG. 16 is a section of a prior art connector.

## LIST OF REFERENCE NUMERALS

10	...	male terminal fitting (terminal fitting)
20	...	inner housing
22	...	smaller portion
35	...	lock portion
37b	...	slanted surface
50	...	outer housing
52	...	larger portion
53	...	tapered portion
53e	...	upper wall (inner wall)
59	...	receiving portion
59a	...	locking surface
C	...	cavity
H	...	connector housing

## ABSTRACT OF THE DISCLOSURE

### [Object]

An object of the present invention is to miniaturize a connector while reducing production costs.

### [Solution]

A connector housing H is provided with cavities C into which male terminal fittings 10 are insertable from behind. The connector housing H is divided into an inner housing 20 and an outer housing 50 into which the inner housing 20 is mountable from front. The outer housing 50 is provided with a receiving portion 59 engageable with a lock portion 35 provided in the inner housing 20 to undetachably hold the inner housing 20. A locking surface 59a of the receiving portion 59 engageable with the lock portion 35 is exposed backward to outside through the cavity C.

### [Selected Figure]

FIG. 8

FIG. 1

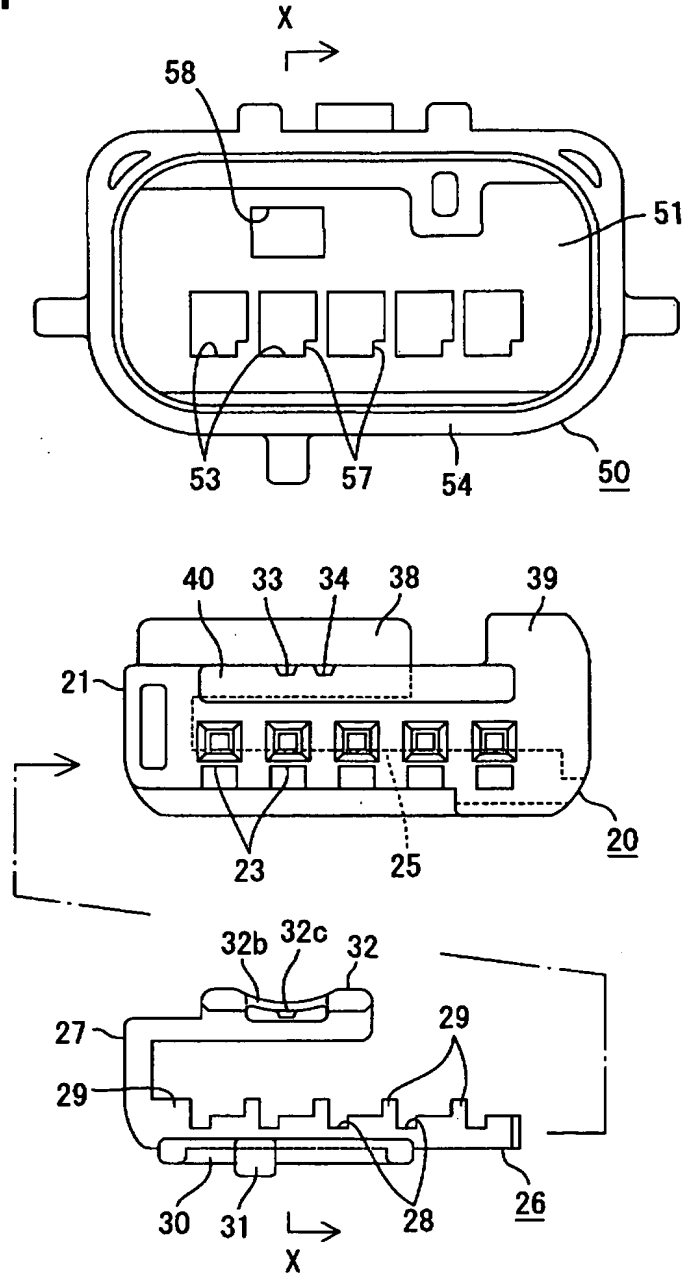


FIG. 2

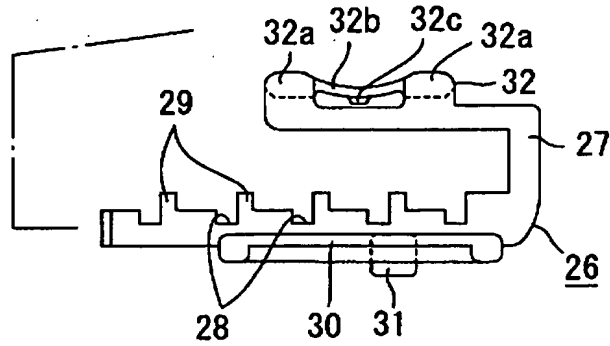
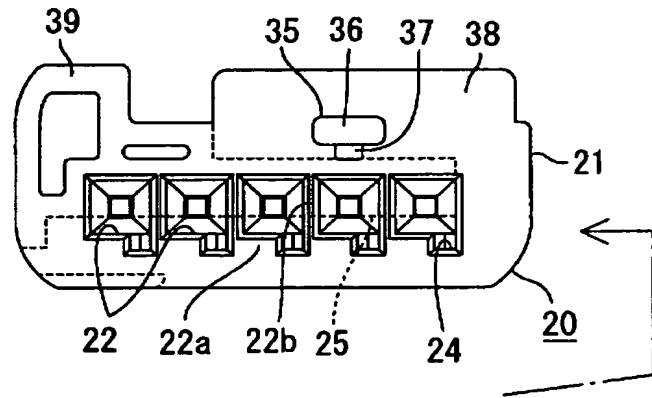
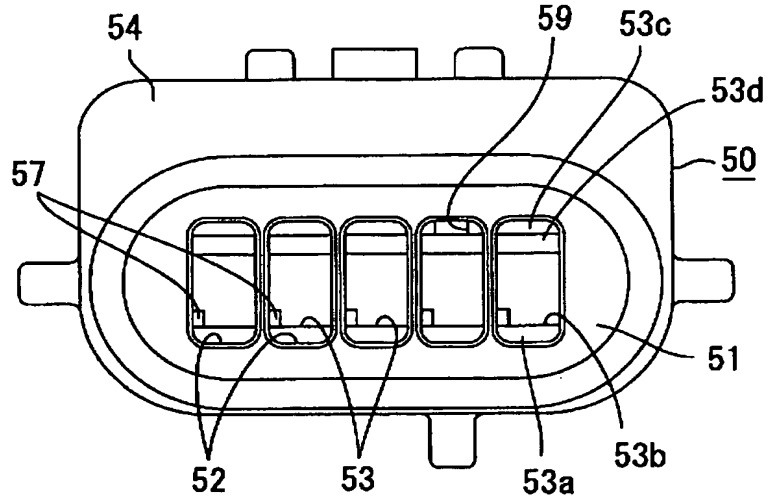


FIG. 3

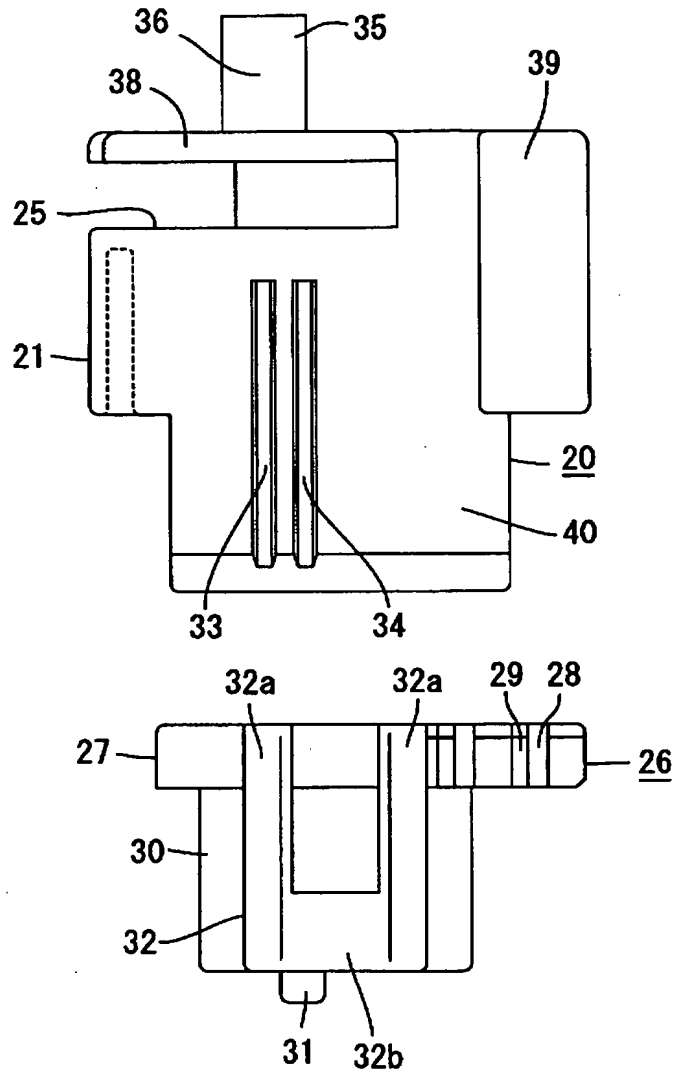




FIG. 4

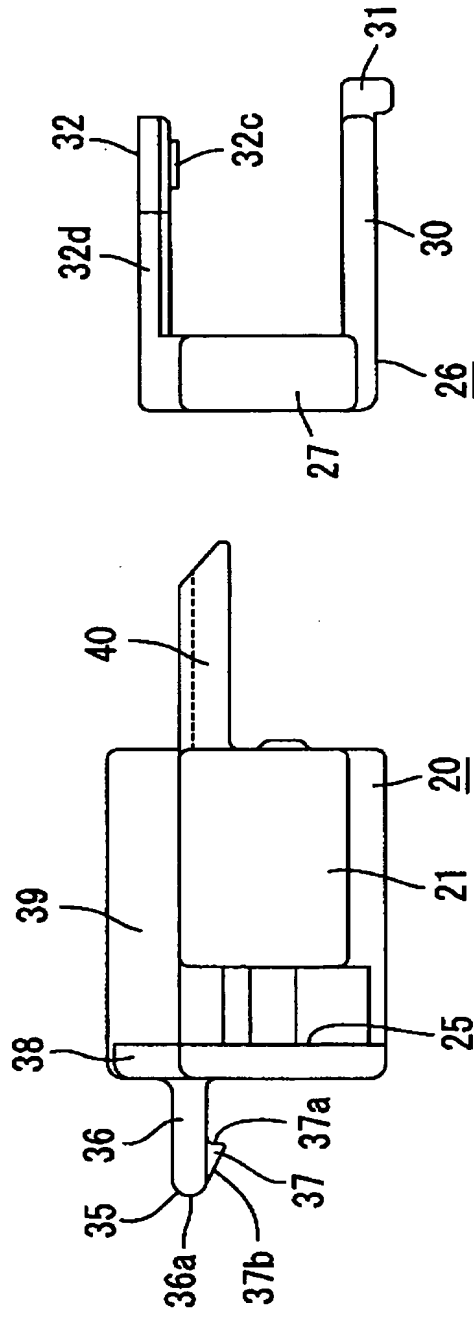


FIG. 5

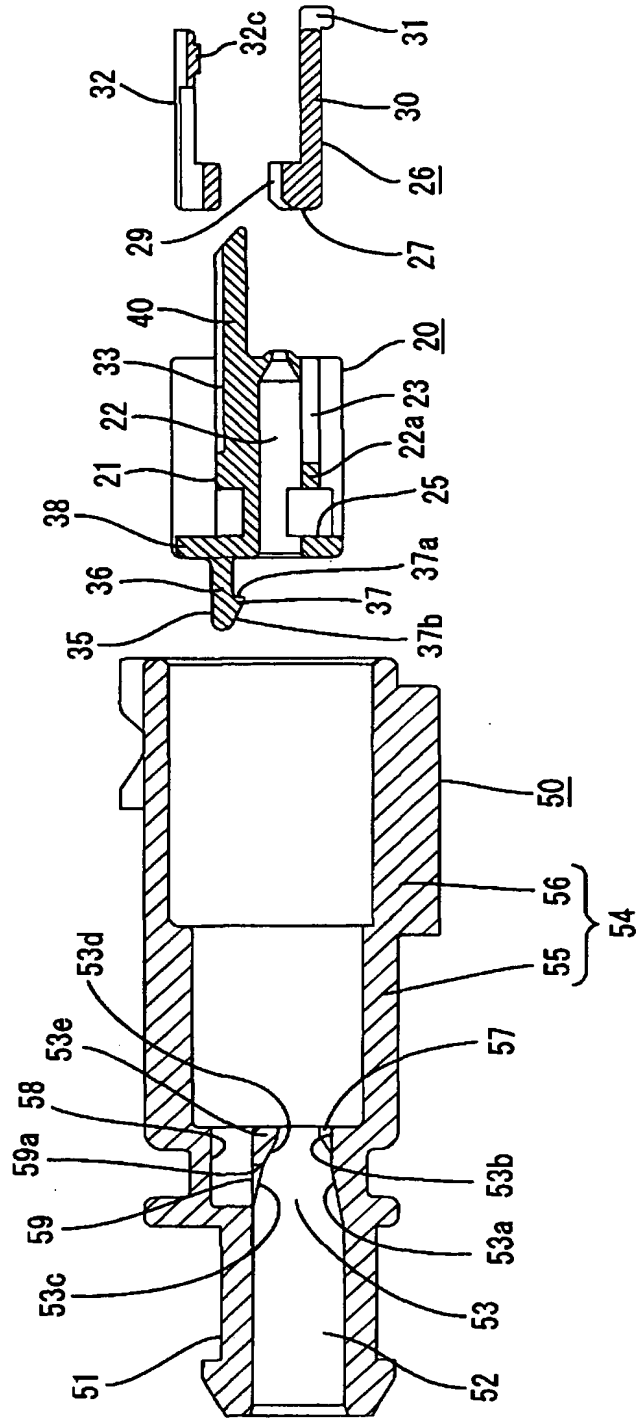


FIG. 6

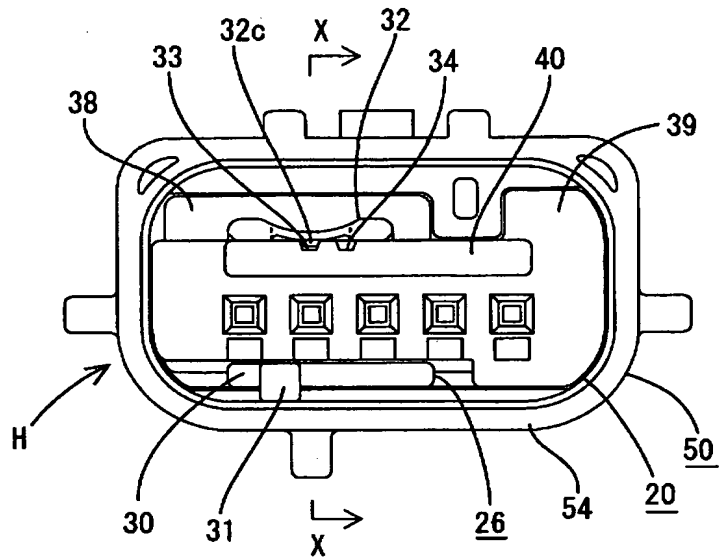


FIG. 7

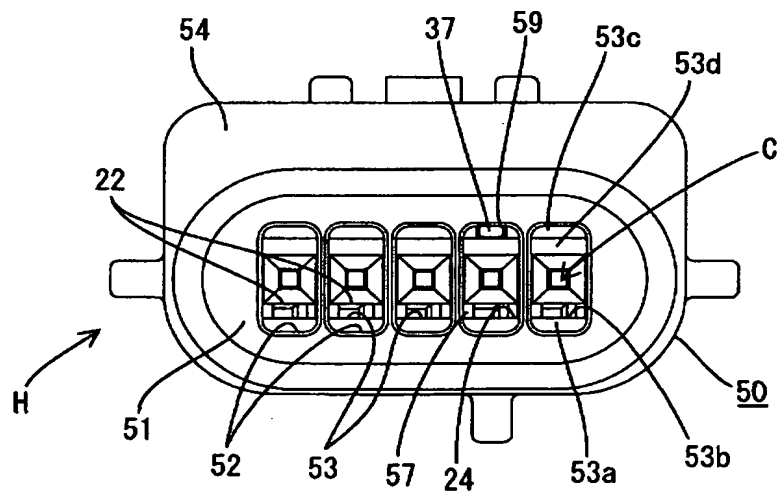


FIG. 8

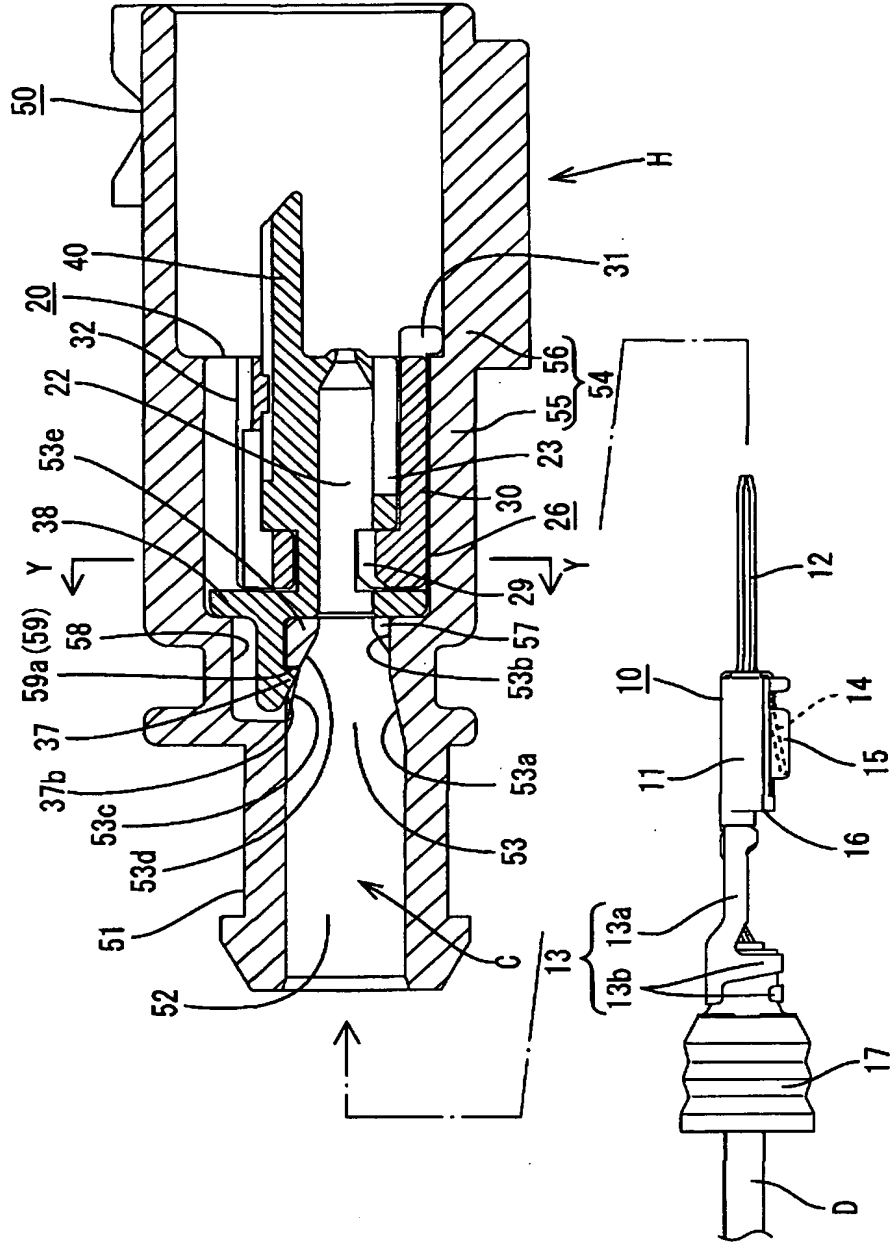


FIG. 9

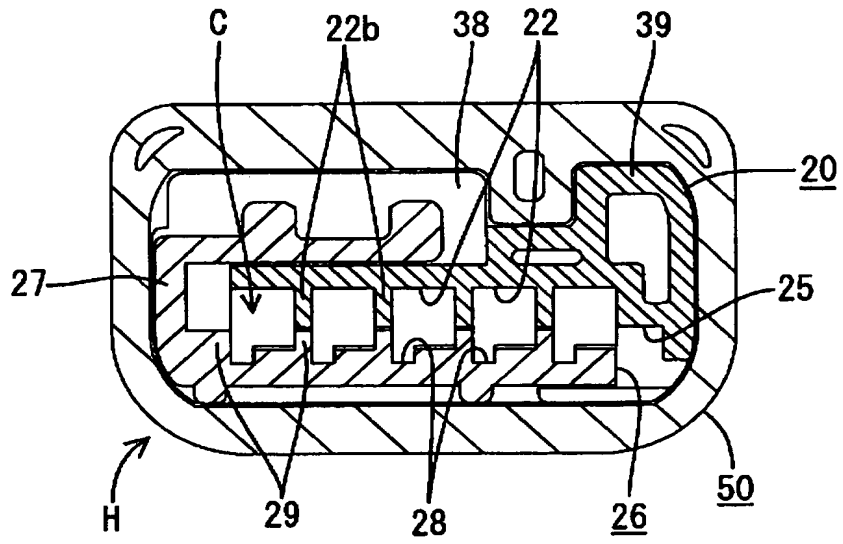


FIG. 10

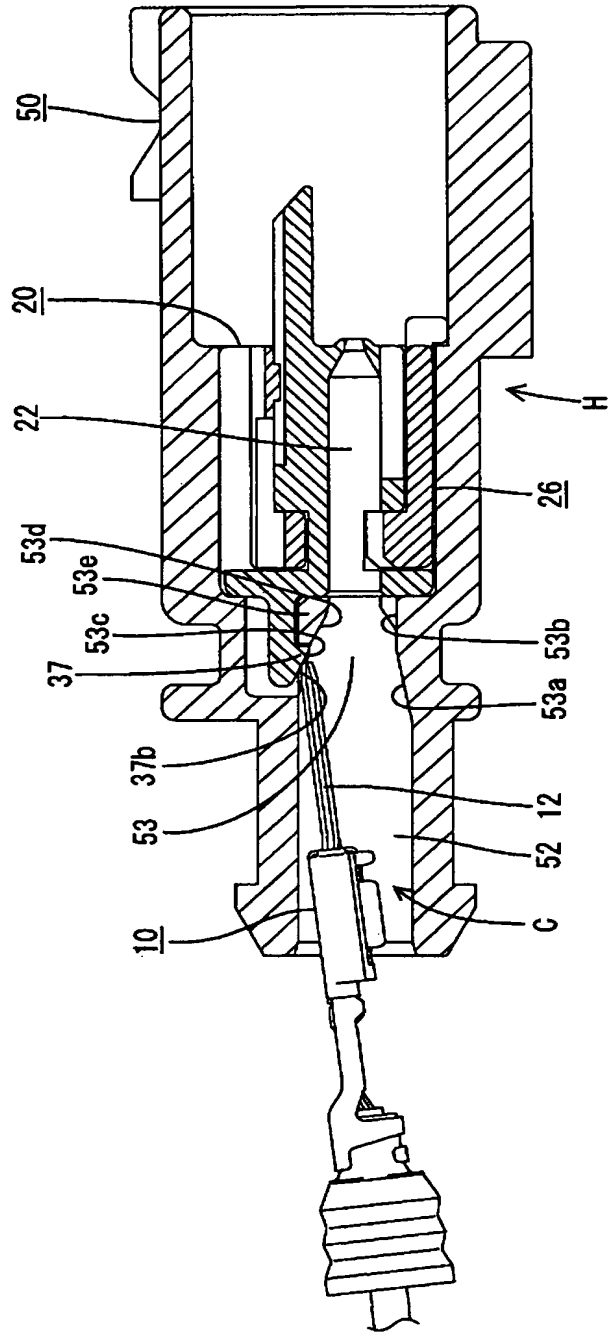


FIG. 11

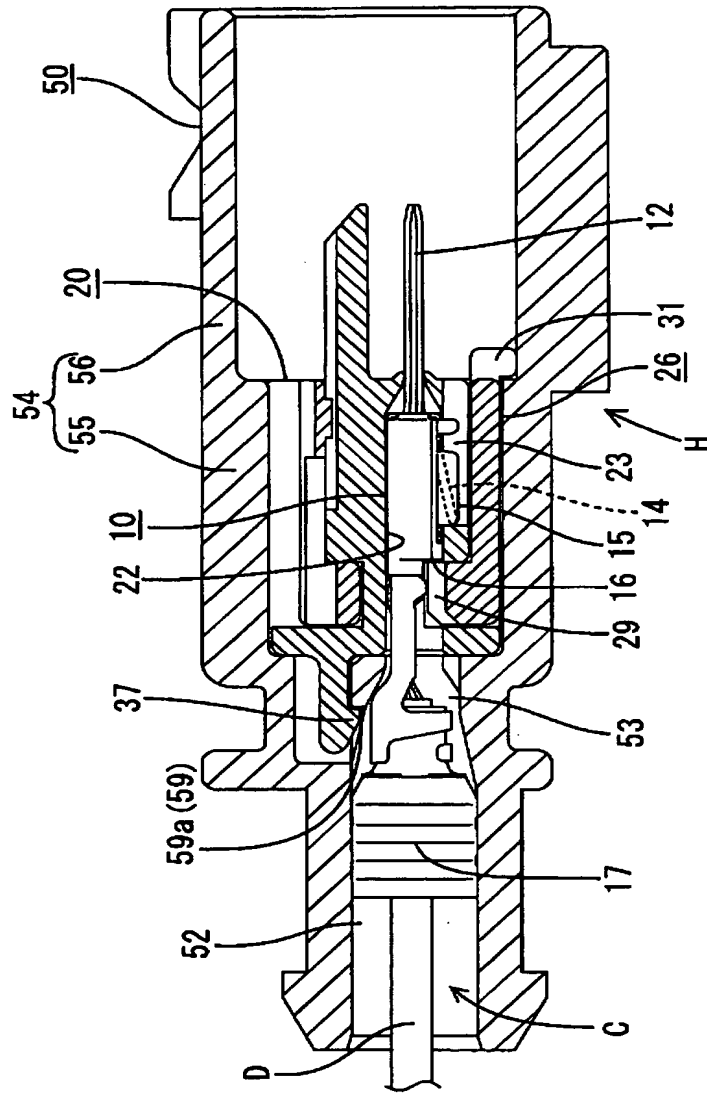


FIG. 12

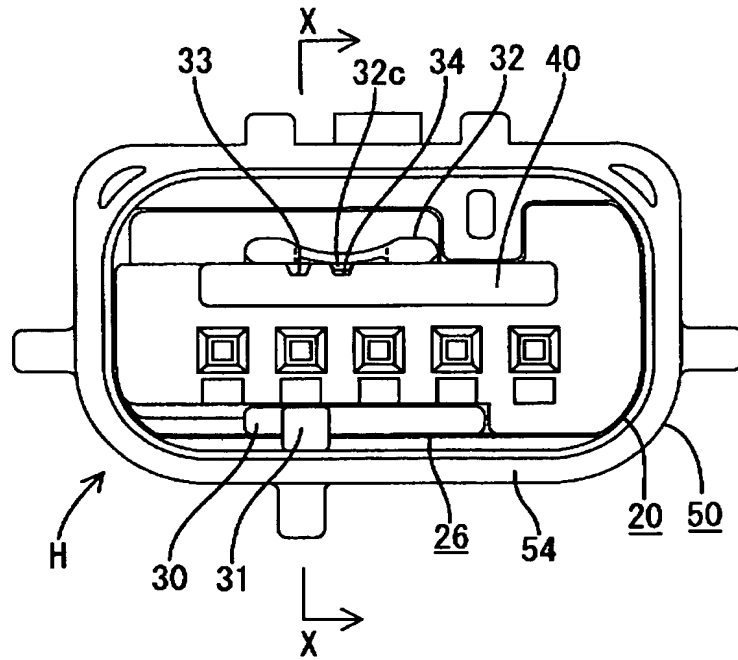




FIG. 13

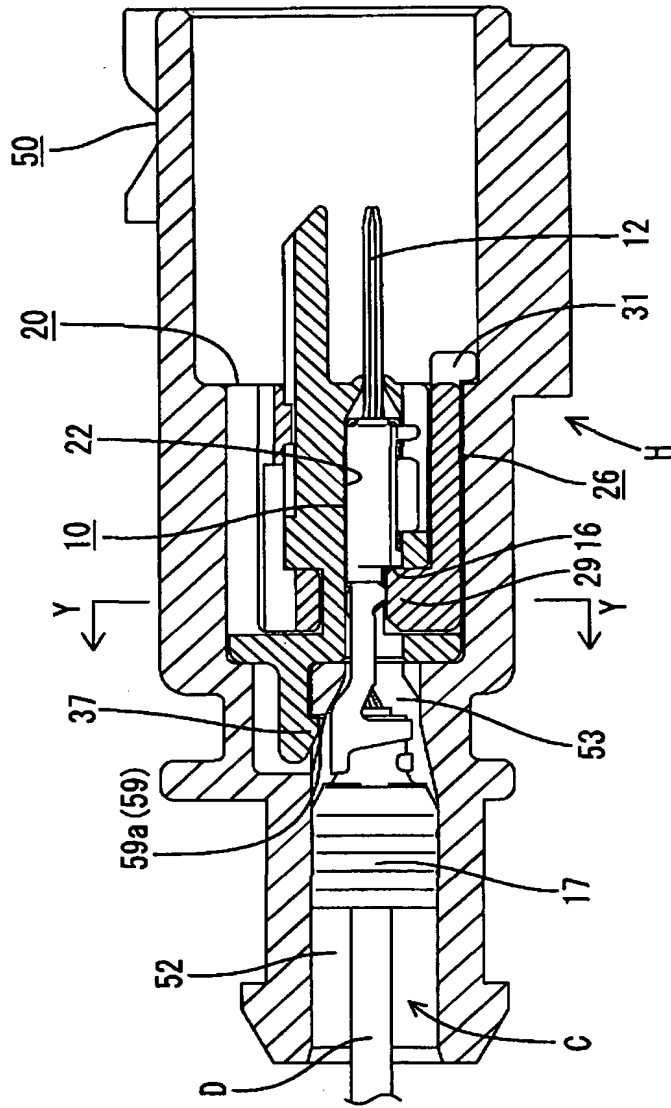


FIG. 14

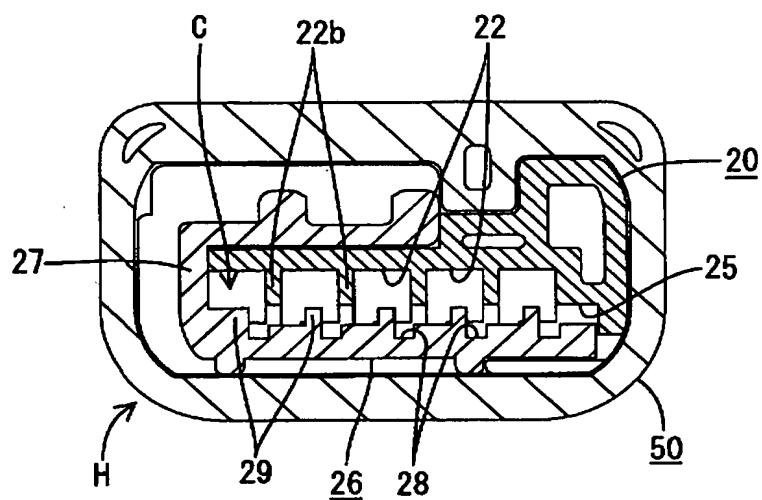


FIG. 15

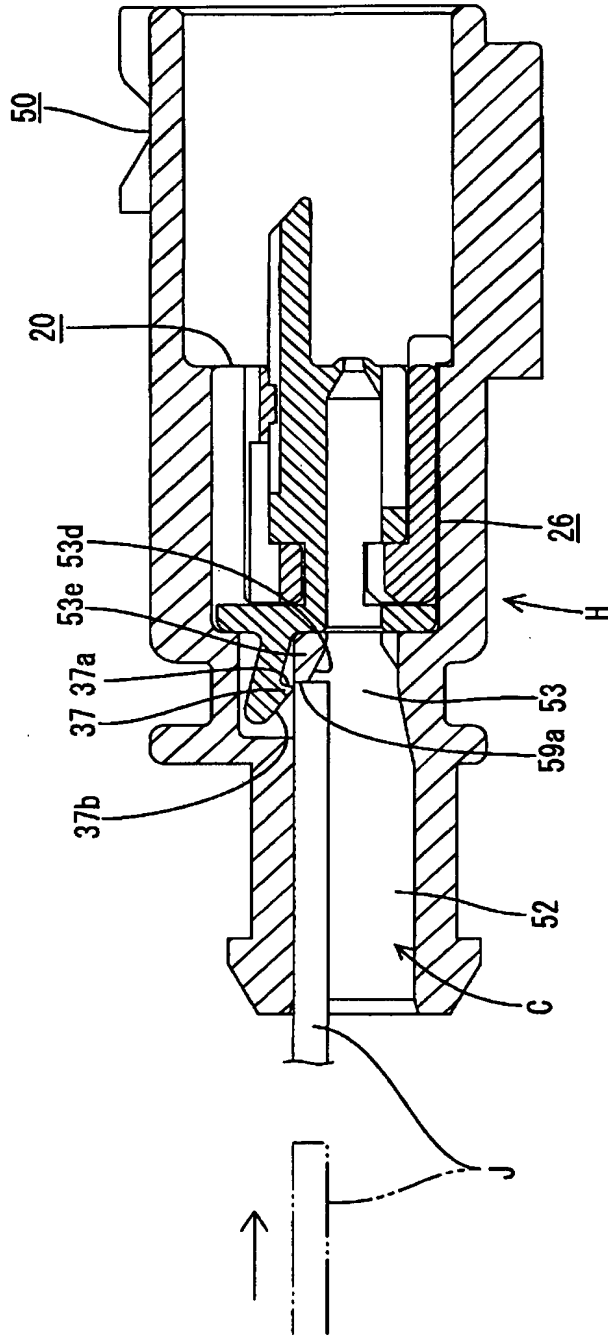


FIG. 16  
PRIOR ART

